The Joint Polarization Experiment (JPOLE)

Presented to

NEXRAD Technical Advisory Committee (TAC)

May 21, 2002

JPOLE Operational Demonstration

The Joint Polarization Experiment will include the first operational test of a polarimetric WSR-88D weather radar. It will also provide an opportunity to investigate many complementary hydrological and meteorological scientific objectives.

TWO Phase Experiment

- Phase I: Collect data sets that will allow a detailed analysis of present (non-polarimetric) and future (polarimetric) WSR-88D rainfall and hydrometeor products (to begin in the spring of 2002).

- Phase II: Collect additional verification data sets using improved infrastructure provided by the addition of community-wide facilities (to begin in the spring of 2003).

The KOUN WSR-88D Radar

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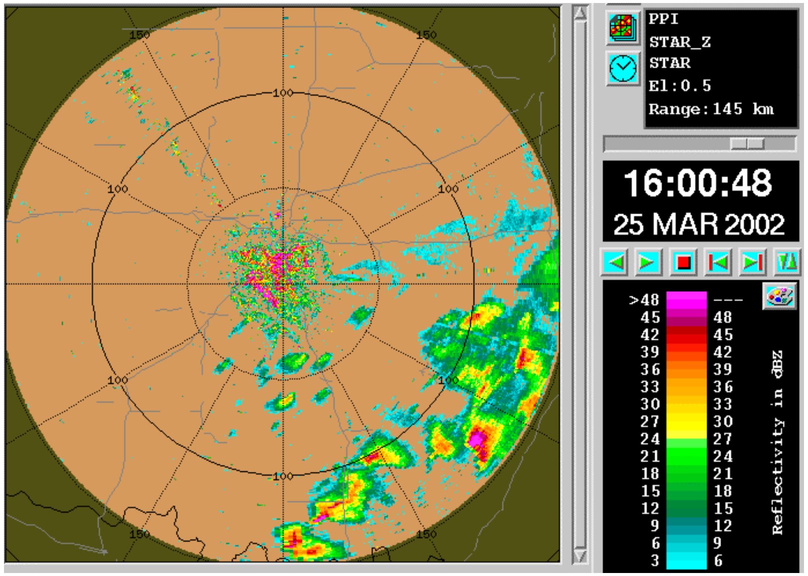
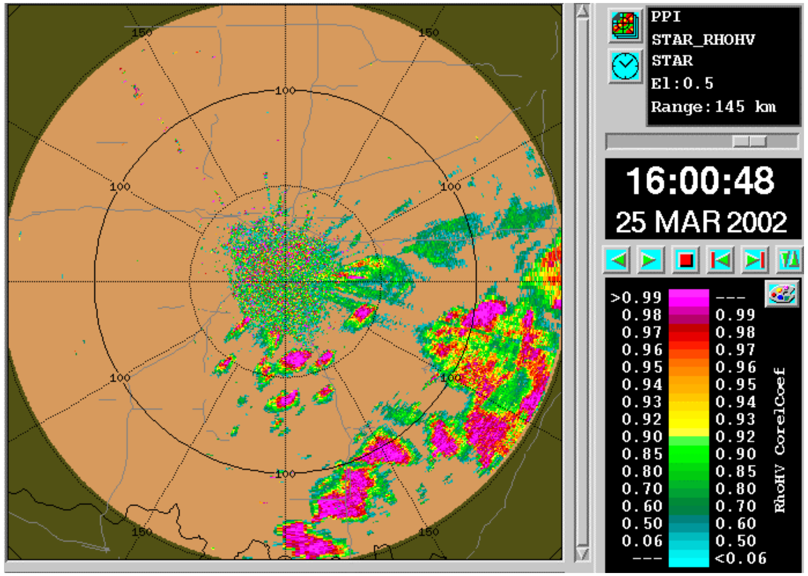
The polarimetric upgrade to the KOUN WSR-88D radar was completed in March of 2002.

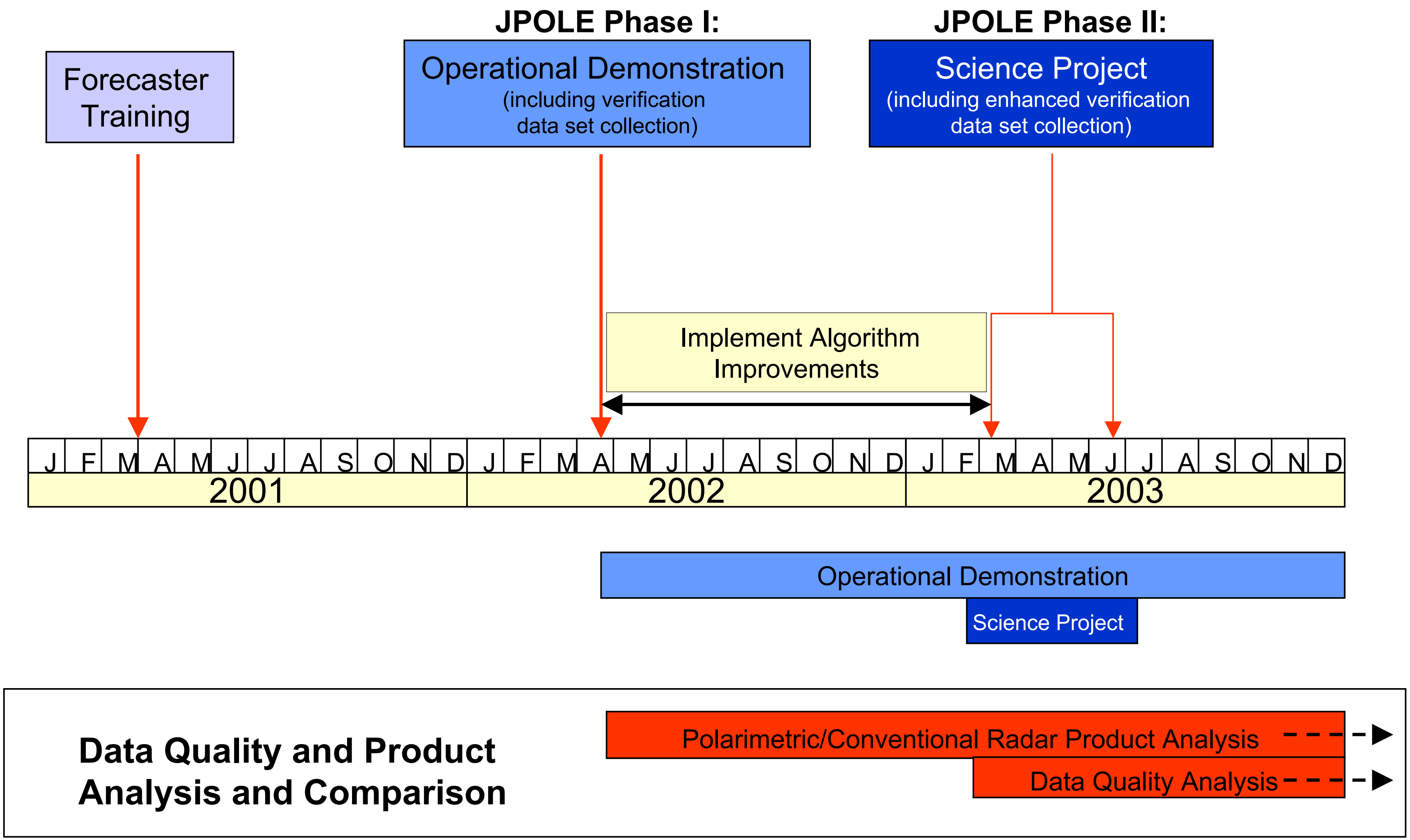
The KOUN radar employs a simultaneous (also referred to as hybrid) transmission scheme. Some advantages of the simultaneous mode are:

- **A more direct estimation of differential phase**
- **A more direct estimation of copolar correlation magnitude**
- **Decoupling of differential phase estimation from Doppler velocity estimation**
- **Less error in polarimetric variables for the same scan rates**





JPOLE Timeline



JPOLE Operations (Delayed)

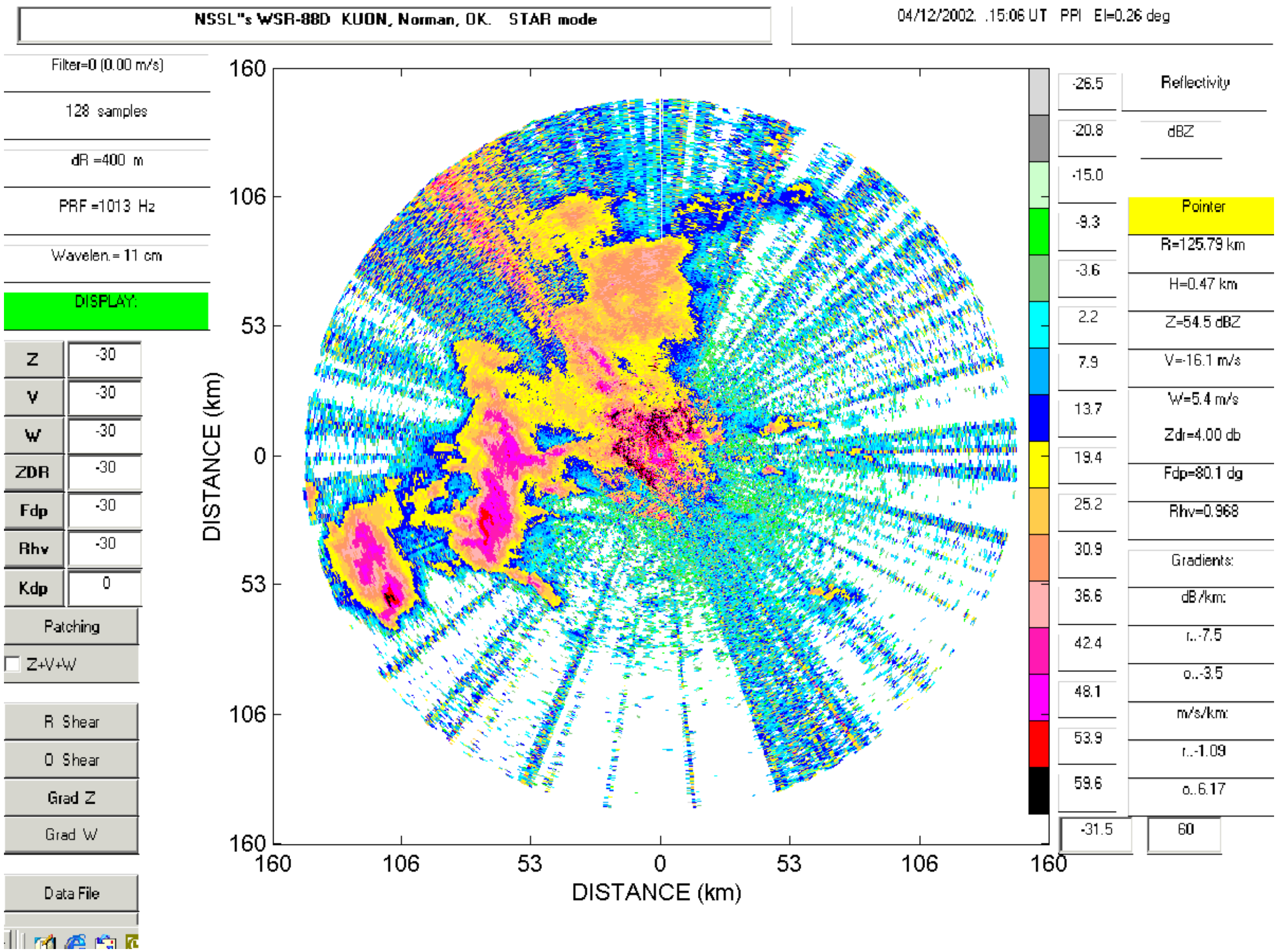
•Interference (KOUN – 2705 MHZ vs. FAA ASR-8- 2710MHZ)

•Radar problems (14 years old – some parts failing)

•Sigmet Interface (Frequency Converter, VCPs, Calibrations data, etc.)

http://www.nssl.noaa.gov/JPOLE

INTERFERENCE



JPOLE Science Objectives

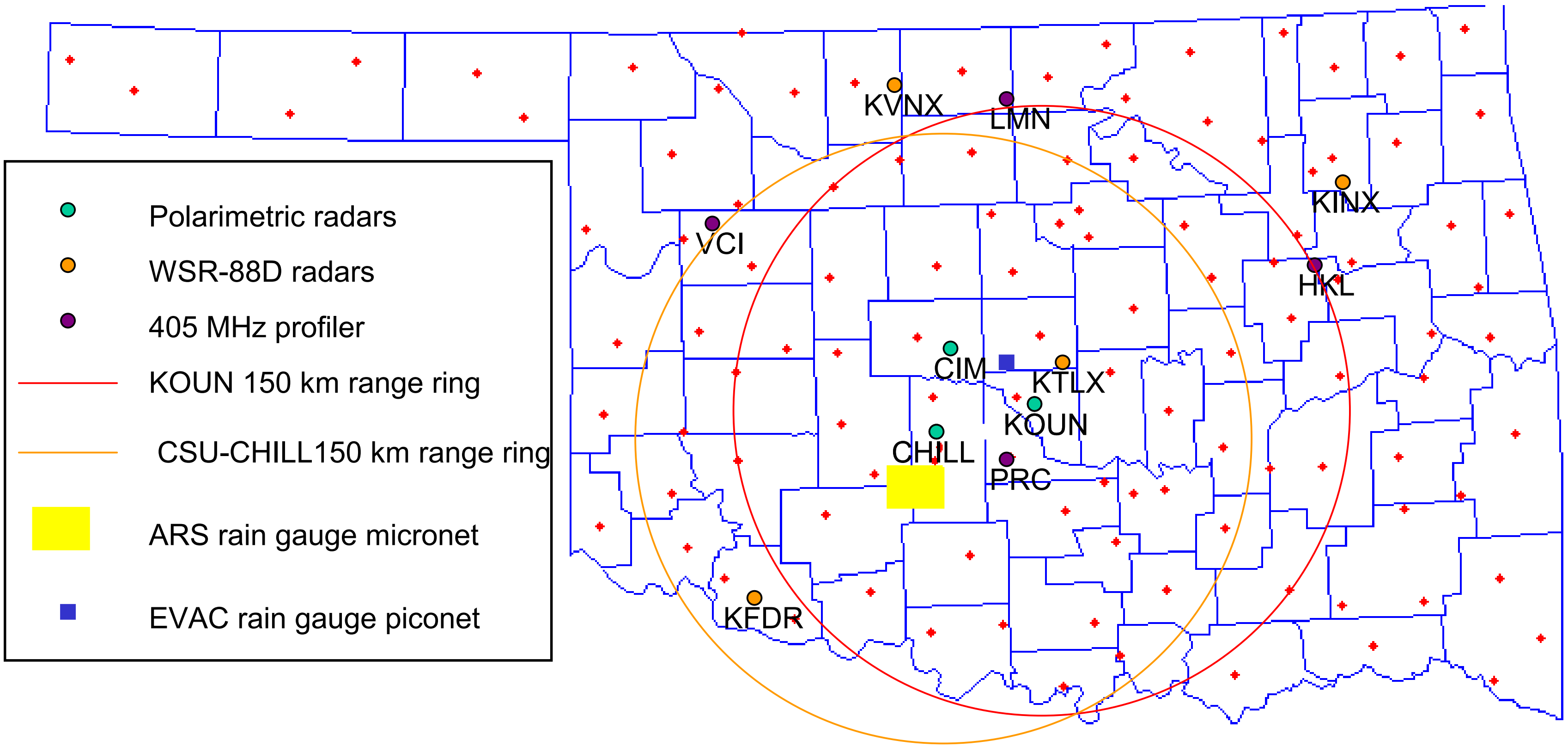
Meteorological:

- Improve physical understanding of polarimetric signatures
- Verify and improve hydrometeor classification schemes
- Develop and verify hydrometeor quantification schemes
- Investigate the use of polarimetric hydrometeor information in cloud resolving models

Hydrological:

- Verify and compare radar rainfall estimates and improve radar rainfall estimators
- Investigate DSD variability
- Measure streamflow and runoff
- Conduct hydrologic modeling

S-band Polarimetric Radar Coverage



CSU-CHILL Radar (NSF facility)

JPOLE will provide the first opportunity to compare alternate and simultaneous modes of transmission. With its ability to transmit in both alternate *and* simultaneous mode, the CSU-CHILL radar is ideal for this investigation.

Concurrent radar data collection by the CSU-CHILL and KOUN polarimetric radars will be used to:

- **Understand the basic assumptions of microphysical retrievals from the simultaneous transmission mode**
- **Provide widespread coverage of several watershed basins**
- **Collect data that can be used to address the other science objectives**

SDSMT T-28 Aircraft (NSF facility)

- The validation of hydrometeor classification techniques is critical to the success of the JPOLE objectives. The T-28 is a unique airborne platform that comes with a suite of instrumentation that is well suited for the validation requirements of the JPOLE field campaign.

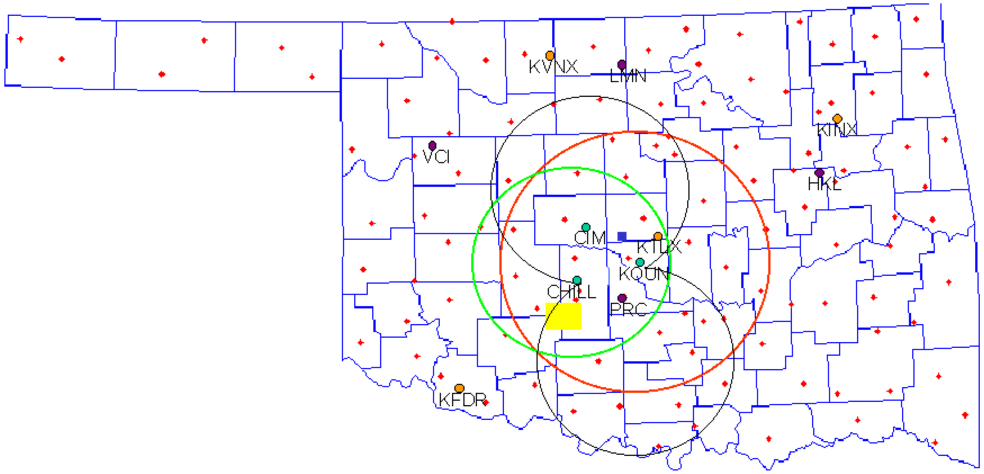
Rainfall Measurements – OCS mesonet

The Oklahoma Climate Survey (OCS) mesonet:

•115 instrumented sites located throughout the state of Oklahoma.

•Average gauge spacing of approximately 30 km.

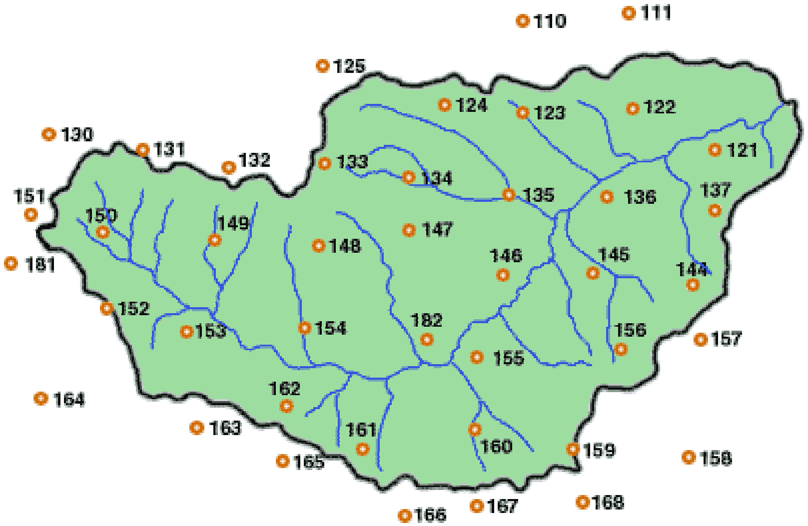
•Data used to investigate mesoscale rainfall accumulation, rainfall estimation errors at long distance, and errors resulting from bright band contamination.

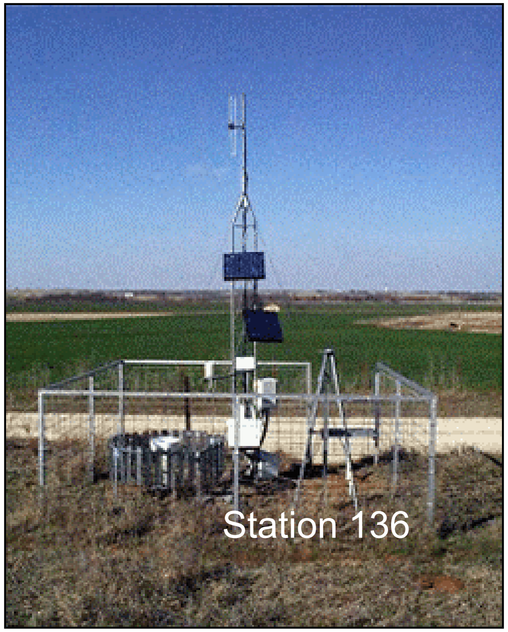


Rainfall Measurements - ARS Micronet

The US Department of Agriculture/ Agricultural Research Service (USDA/ARS) micronet:

- 42 instrumented sites located over the Little Washita watershed
- Average gauge spacing of approximately 5 km
- Center of micronet approximately 70 km from the KOUN radar
- Data from the micronet will be valuable for the evaluation of polarimetric rainfall estimates for spatial scales typical of a watershed





Rainfall Measurements – OU/EVAC Piconet

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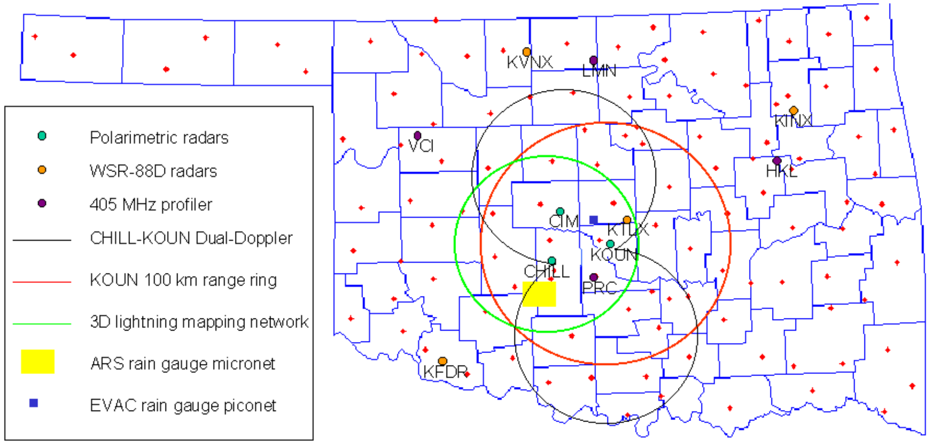
The University of Oklahoma/ Environmental Verification and Analysis Center (OU/EVAC) piconet:



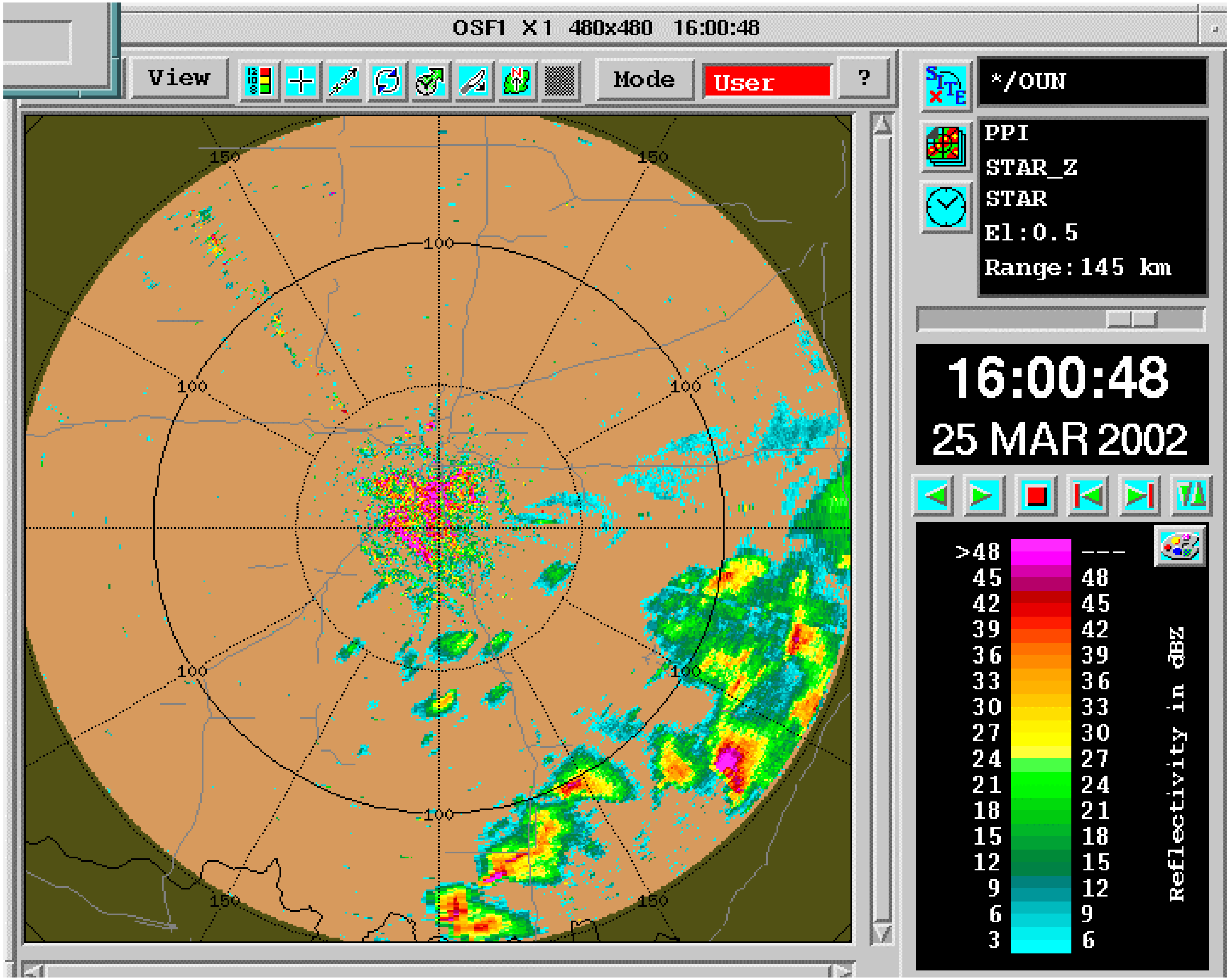
•25 rain gauges in an approximate 3 km by 3 km region near Will Rogers Airport in Oklahoma City.

•Average gauge spacing of approximately 0.65 km

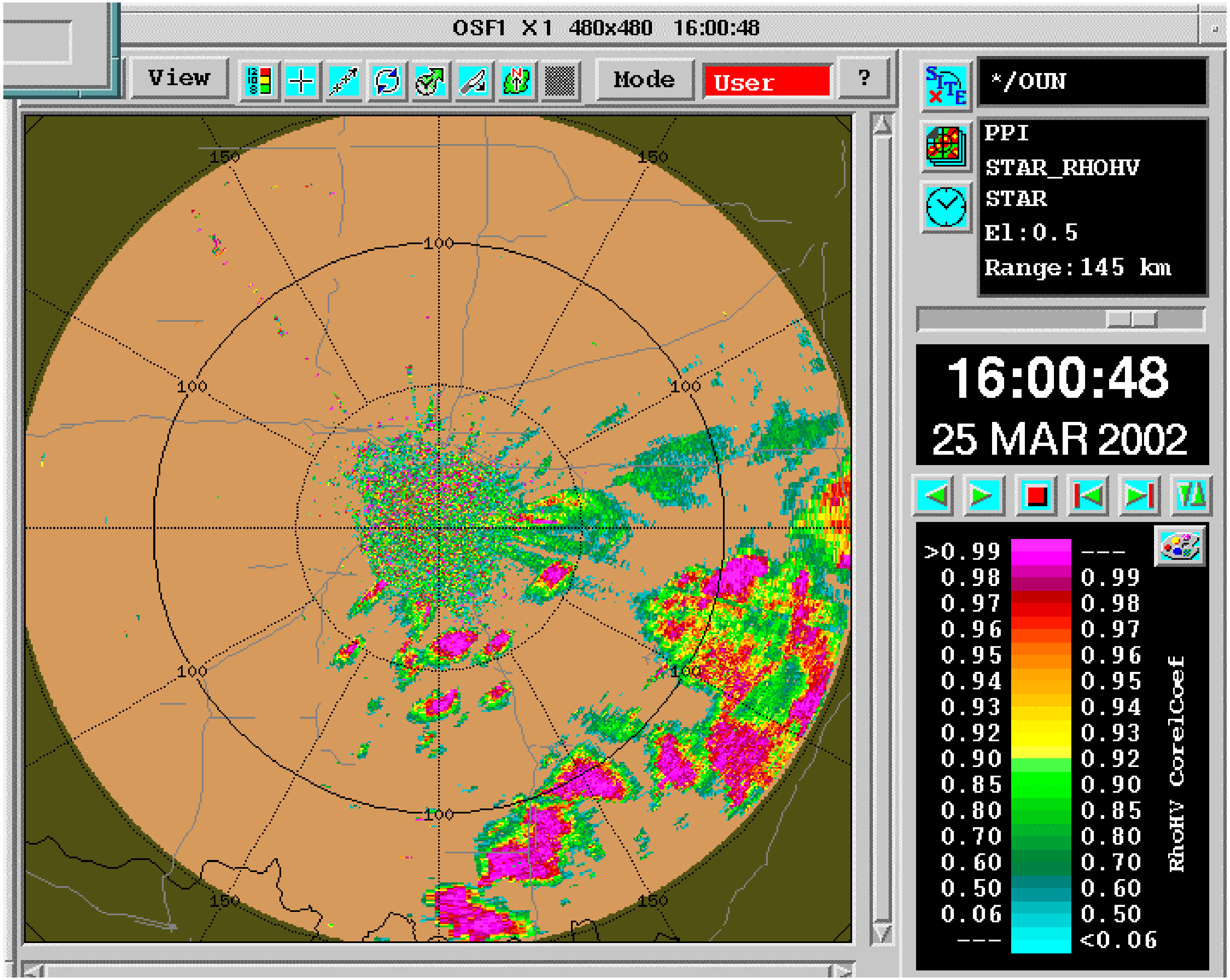
•Center of micronet approximately 20 km from the KOUN radar

•Data from the piconet will be valuable for the evaluation of polarimetric rainfall estimates for urban flash flood events

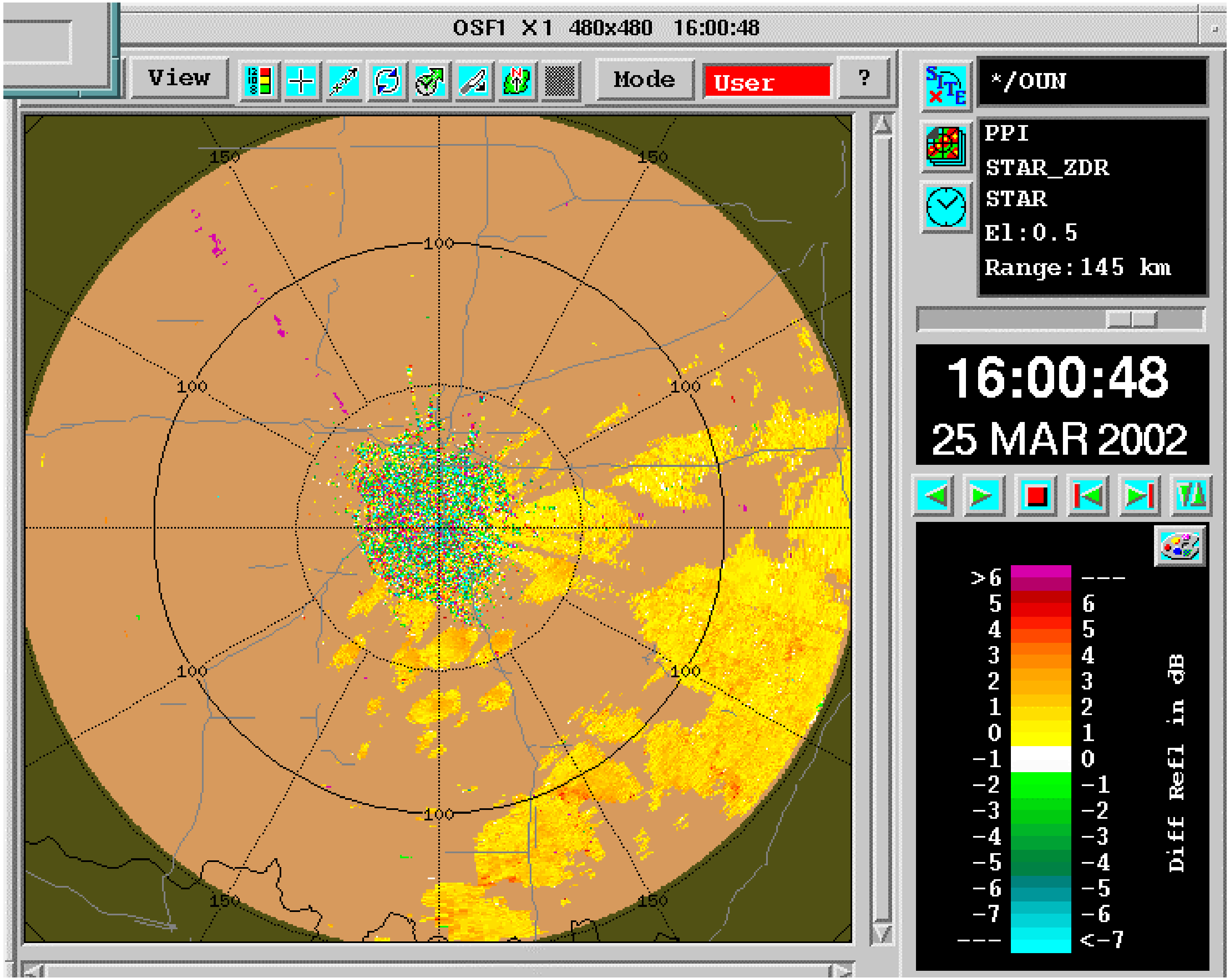
KOUN Reflectivity (Z)



KOUN Correlation Coefficient (ρ_{HV})



KOUN Differential Reflectivity (Z_{DR})



KOUN Differential Phase (Φ_{DP})

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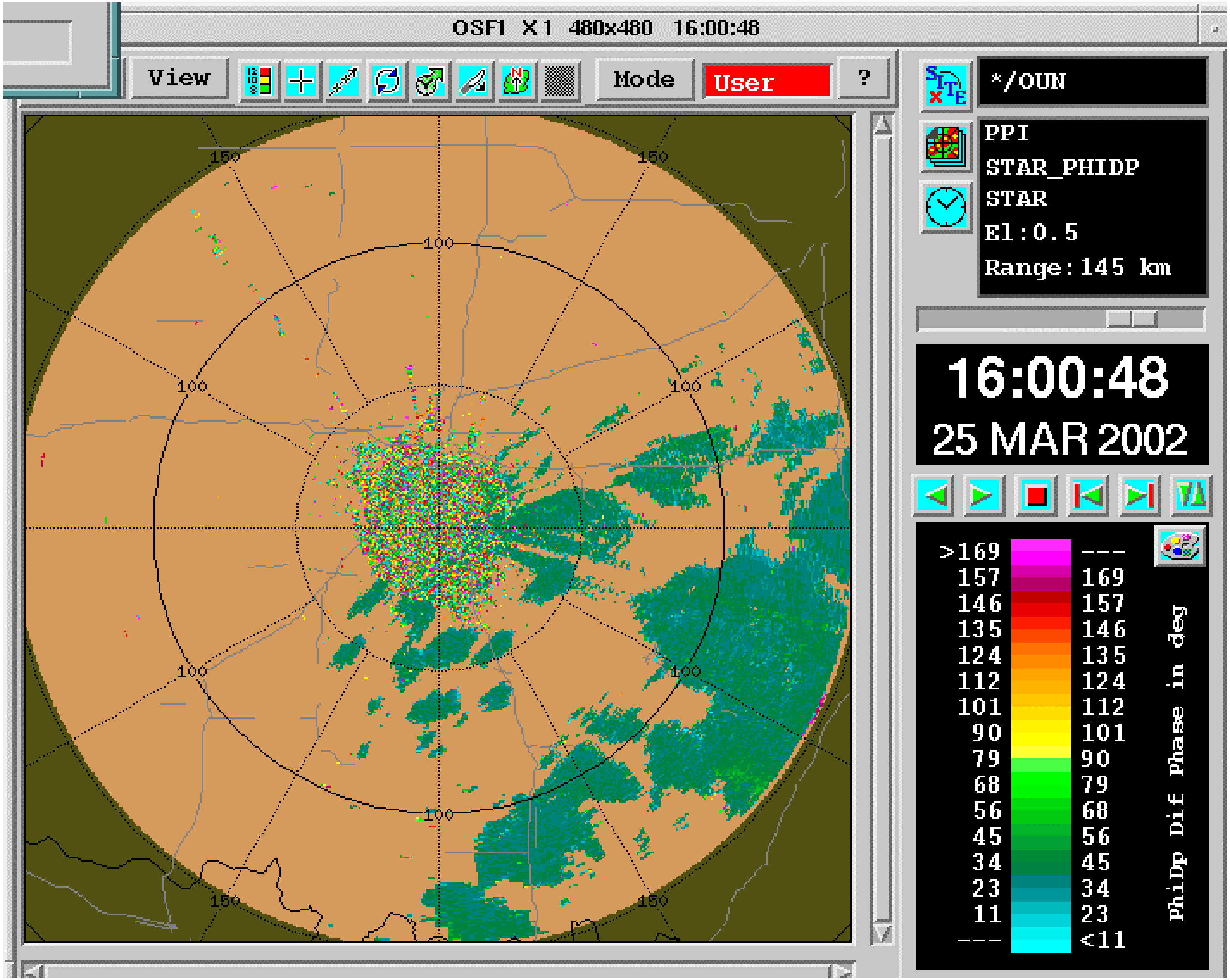
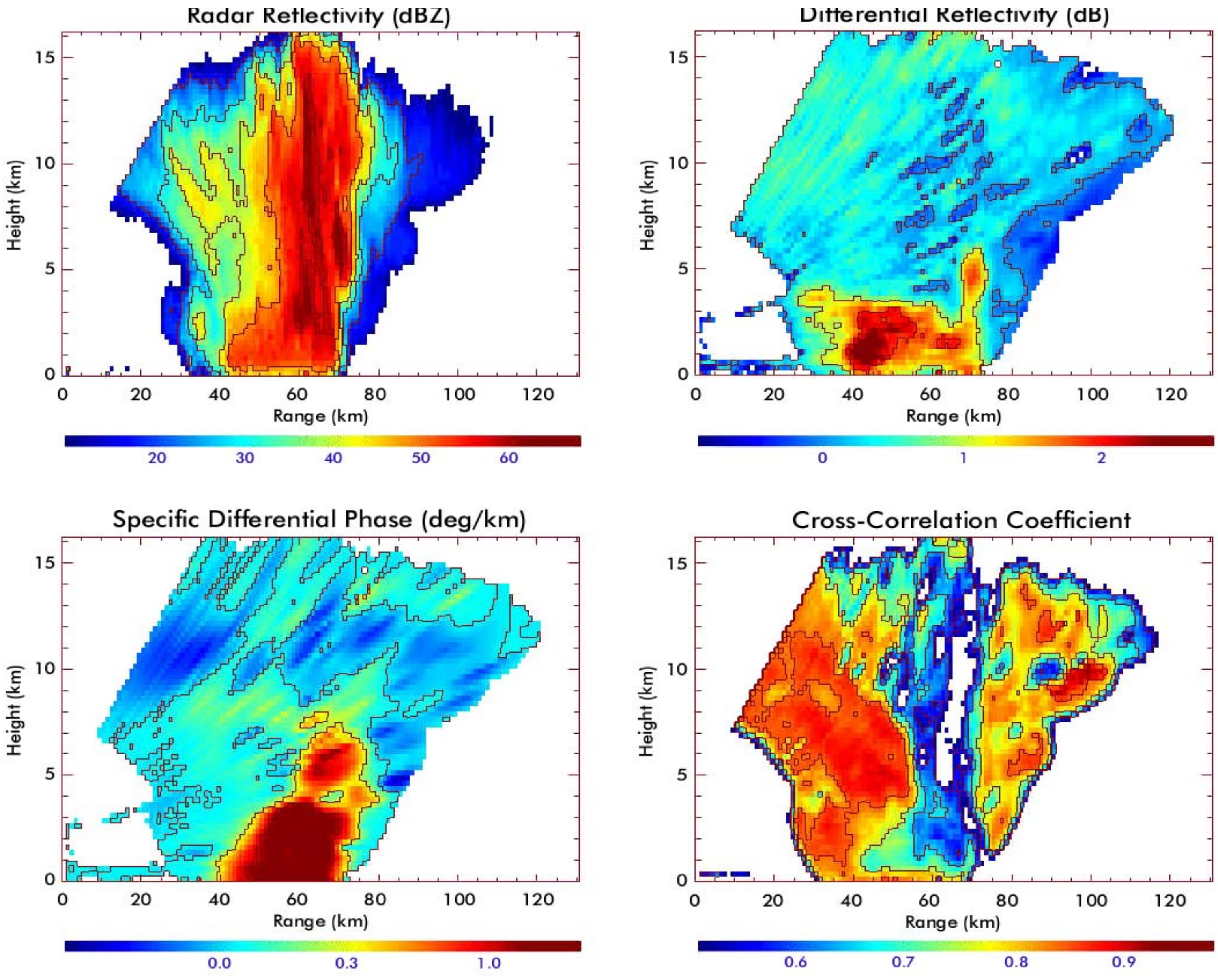
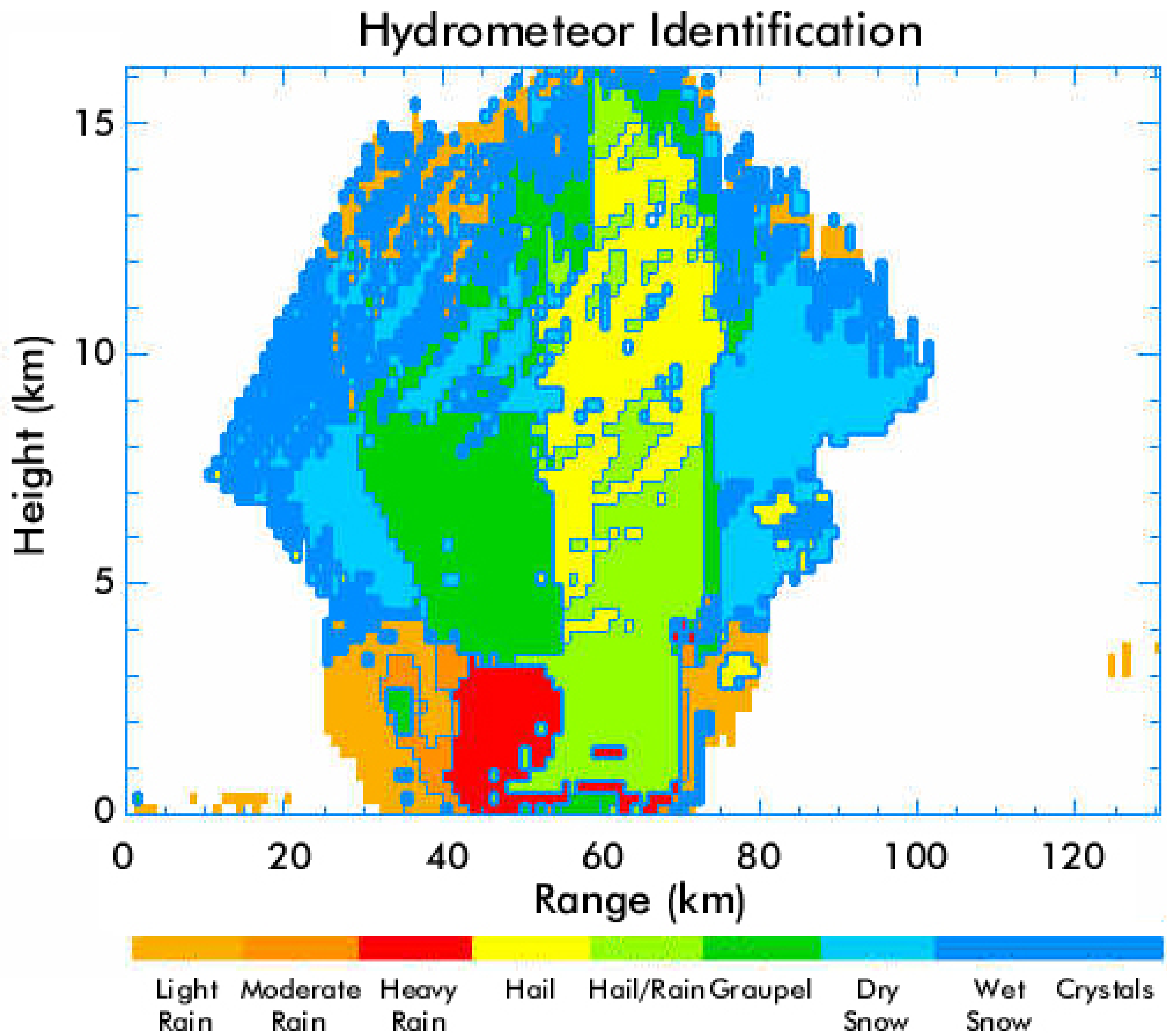


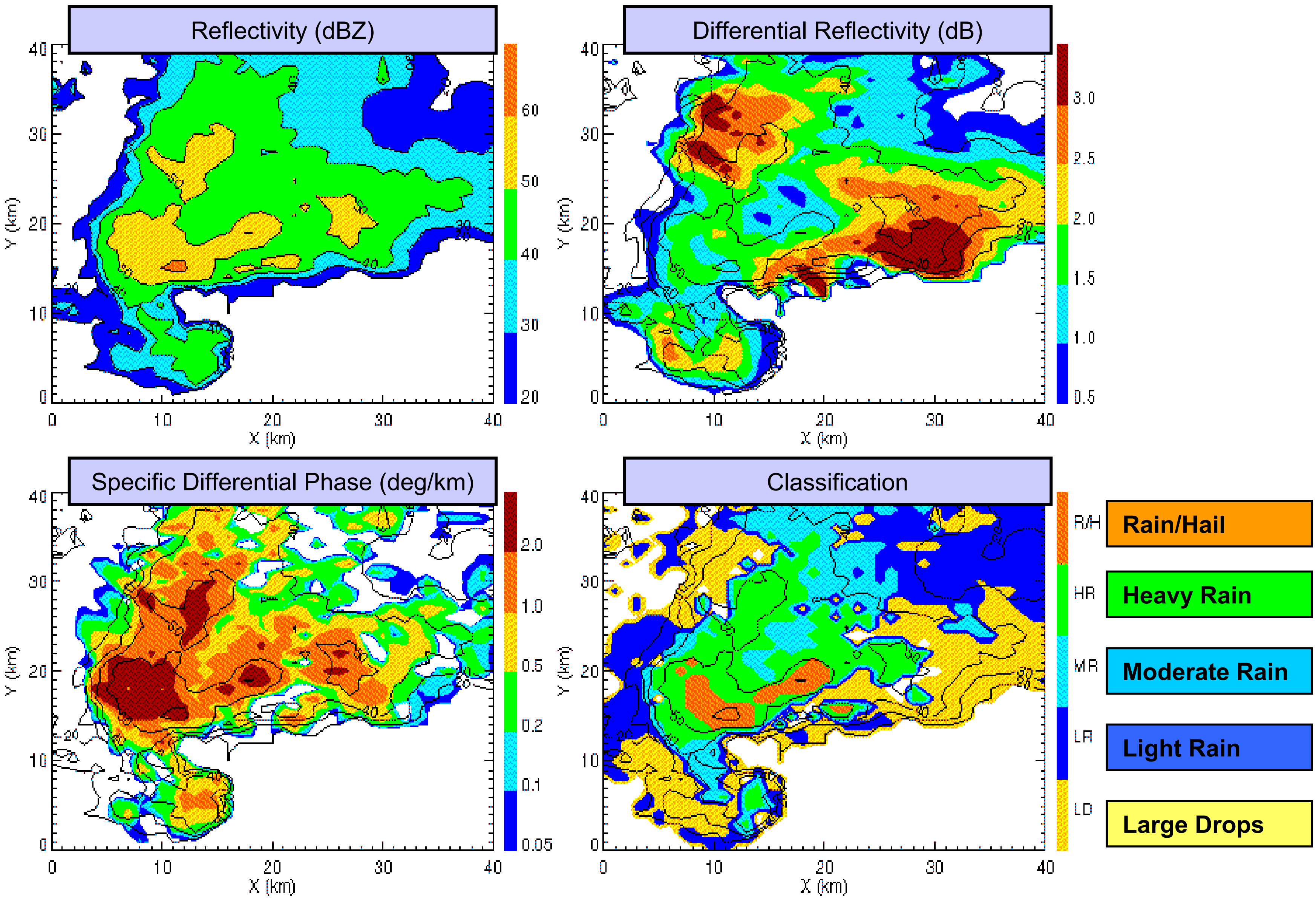
Polarimetric Variables in a Hailstorm



Hydrometeors in a Hailstorm

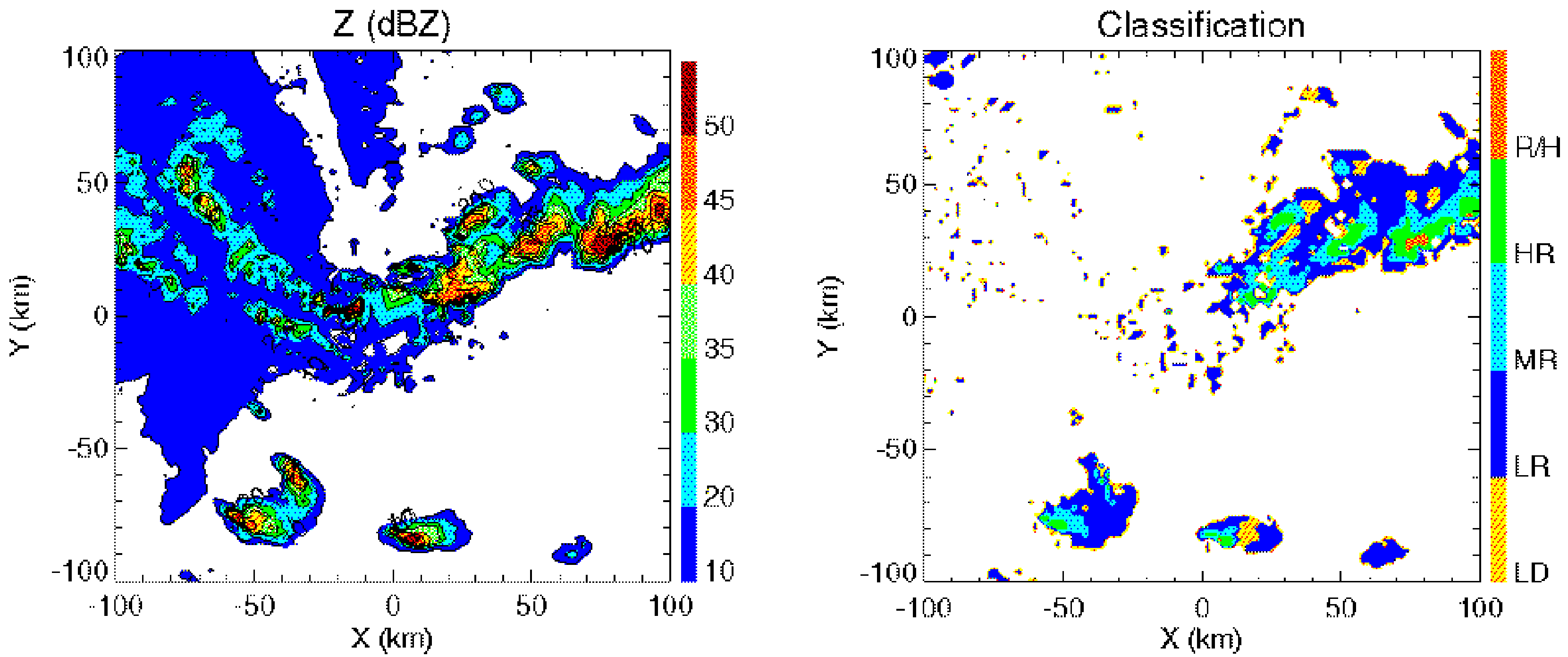


PPI1 Classification Algorithm



PPI2 Classification Algorithm

Identification and Removal of AP and Biological Scatterers



- An extensive region of AP and biological scatterers (birds) was identified and removed.
- Meteorological data were then classified and put into five categories: Rain/Hail, Heavy Rain, Moderate Rain, Light Rain, and Large Drops.

RHI Classification Algorithm

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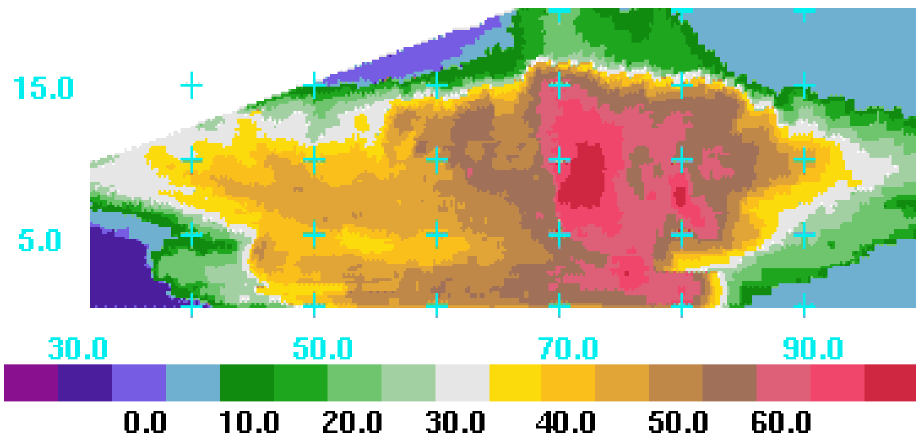
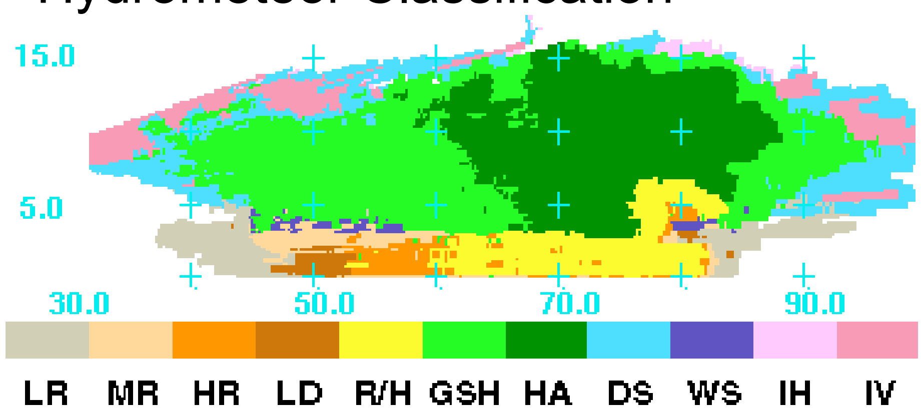
Radar Reflectivity



Hydrometeor Classification

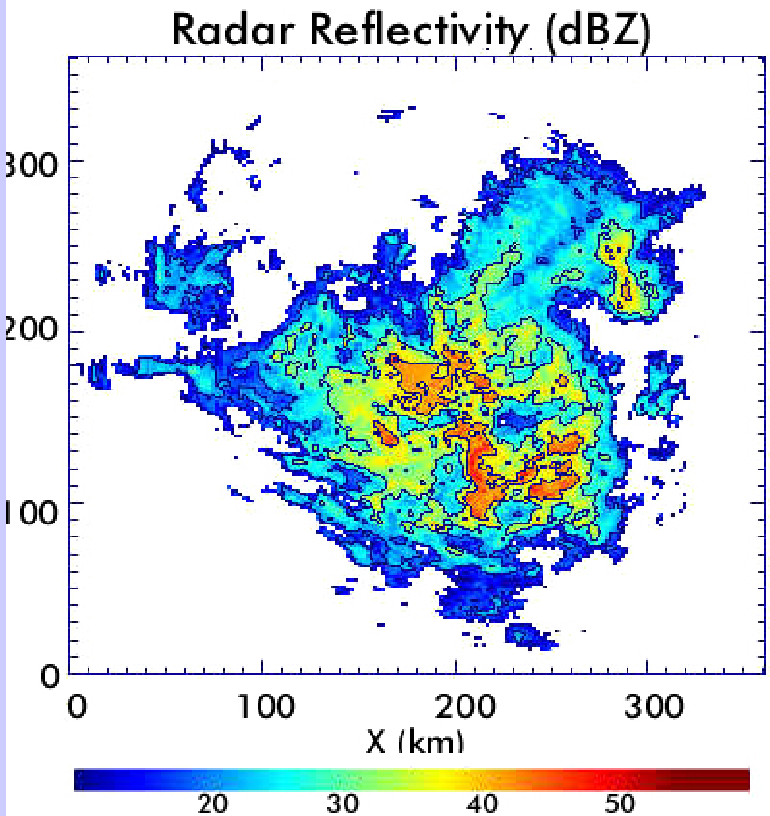


Hydrometeor Classification RHI Algorithm

- Light Rain
- Moderate Rain
- Heavy Rain
- Large Drops
- Rain/Hail
- Graupel/Small Hail
- Hail
- Dry Snow
- Wet Snow
- Horizontal Ice
- Vertical Ice

Discrimination Between Snow, Melting Snow, and Rain

Reflectivity
Large Values indicate strong echo power



Differential Reflectivity
- Large values indicate melting snow
- Moderate values indicate rain
- Small values indicate dry snow